

DEPARTMENT OF ENVIRONMENTAL QUALITY
REMEDATION DIVISION
PETROLEUM RELEASE SECTION

Technical Guidance Document #13

Monitoring Well Construction Requirements

Monitoring wells (groundwater and vadose) are normally constructed as part of phased site assessments, remedial investigations, or corrective action activities. Proper design and construction of groundwater and vadose wells are essential for the acquisition of reliable subsurface data and representative samples. In such design and construction, site-specific geological, hydrogeological, physical, and geochemical conditions should be considered. It may even be appropriate to develop a conceptual hydrogeological model prior to well design and construction, particularly for sites with relatively complex hydrogeologic settings.

Groundwater and vadose well installation should be properly planned with the drilling activities, prior to the initiation of field work and include specifications on well construction materials and the installation procedures. Monitoring wells should be constructed as designed, except in situations where unexpected subsurface conditions warrant modifications during installation, and which should be clearly documented. Monitoring well construction requirements are defined by the Board of Water Well Contractors, Administrative Rules of Montana, Title 36, Chapter 21. This guidance applies to monitoring wells constructed at leaking underground storage tanks sites and defines additional requirements.

A. General Considerations

- 1) Drilling – The selection of an appropriate drilling method for constructing monitoring wells should minimize both the disturbance of penetrated geologic materials and the possibility of aquifer contamination by the introduction of air, fluids, muds, and contaminated soil. Where possible, the drilling method selected should allow detection of the saturated zones encountered during the drilling, since the well is typically screened in the first aquifer encountered.
- 2) Wherever possible, drilling should be accomplished with a hollow-stem, continuous flight auger drill rig. Other types of drilling methods may be used if conditions warrant and are approved by the DEQ-PRS.
- 3) No drilling fluids are to be used unless approved by the DEQ-PRS prior to drilling.

B. Well Construction Materials

- 1) Prior to installation, well casings, casing fittings, screen and all other components to be installed in the well boring should be thoroughly cleaned by an appropriate method. Well materials that are cleaned and wrapped by the factory are acceptable. Care should be taken to not contaminate the casing during installation.
- 2) Well construction materials should be compatible with the constituents being investigated and should not contribute, capture, mask, or alter the constituents to be analyzed.

- 3) The well materials should be of sufficient durability to withstand deterioration by the suspected contaminants.
- 4) The well screen should be commercially manufactured, corrosion resistant, and have sufficient column and collapse strength.

C. Well Construction Standards

- 1) The well identification number and well type should be permanently affixed to the exterior of the well security structure.
- 2) Well casing should be flush-threaded. Use of organic solvents or cements is not acceptable. All well casing should have a bottom cap or plug.
- 3) Monitoring well casing diameter should not be less than 2-inches or greater than 6-inches unless specifically approved by the DEQ.
- 4) The following are minimum boring diameters for the respective casing sizes:

Casing Inside Diameter (I.D.)	Minimum Boring Diameter
2 inches	6 inches
4 inches	8 inches
6 inches	10 inches

In general, the borehole diameter must be 4-inches greater than the proposed casing size. Other casing and boring diameters will need to be specifically approved by the DEQ.

- 5) Well screen and blank casing should be suspended from the ground surface and not allowed to rest on the hole bottom during well construction. When casing is installed in a hollow-stem auger hole, centralizers are not required because the auger centers the screened casing. In borings that do not have the hollow-stem for installation, centralizers should be placed from the bottom up, every 20 feet on screen sections greater than 20 feet in length and every 40 feet on the blank portion of the well casing. For well casing with a screened interval of less than 20 feet in length, centralizers should be placed on the top and bottom of the screened interval, and every 40 feet on the blank portion of the well casing.
- 6) Wells that are designed to evaluate water table conditions should be designed and constructed to provide sufficient length to accommodate expected seasonal groundwater fluctuations and should extend a minimum of 5 feet above the top of the saturated zone. Generally, the screened interval should not exceed 10 to 15 feet into the saturated zone. If deeper sections of the aquifer will be investigated, or the well is going to be used for remediation purposes, then design and site specific sampling considerations should be discussed with DEQ.

- 7) Groundwater wells should be constructed with a filter pack. The filter pack should extend to at least 2 feet above the top of the screened interval. Depending on site conditions, the filter pack may need to be tremied into place. When using a hollow-stem auger, the augers may be used as a tremie. Care should be taken to prevent bridging of the filter pack during placement.
- 8) Sieve analyses performed on the actual aquifer formation material will allow for design of an effective filter pack and screen size. During initial drilling, formation material may be retained and sieve analysis performed to develop a proper well design if given prior approval by DEQ.
- 9) Following placement of the filter pack and prior to placement of the bentonite transition seal, the well should be surged to ensure that the filter pack level has stabilized.
- 10) A minimum 3-foot thick bentonite transition seal should be placed directly on top of the filter pack. Depending on site conditions, the bentonite may have to be tremied into place to prevent bridging when being placed. The bentonite seal should be placed and hydrated in accordance with manufacturers specifications.
- 11) The depth of the annular seal should be in accordance with the Board of Water Well Contractors, Administrative Rules of Montana, Title 36, Chapter 21. For cases where the annular seal is shallower than the Board rules, DEQ shall review the modified construction.
- 12) The annular space from the top of the bentonite transition seal to the base of the surface seal shall be filled with either a cement, a cement-bentonite, or bentonite grout. The grout shall be an approved sealing material as specified by the Board of Water Well Contractors, Administrative Rules of Montana, Title 36, Chapter 21.
- 13) The surface seal shall consist of a concrete able to withstand the maximum anticipated load without cracking or deteriorating. The concrete should meet Class A specifications which meet a minimum 4000-pound compressive strength. Where appropriate, the lower end of the surface seal should extend at least one foot below the frost line to prevent damage from frost heaving.

C. Well Head Completion Standards

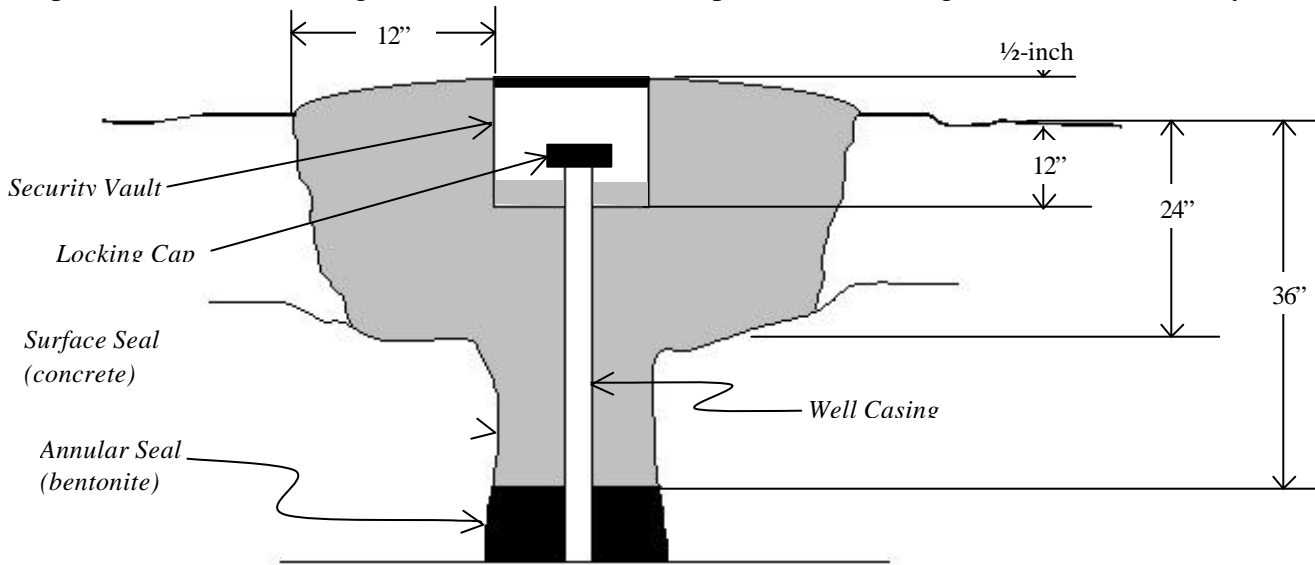
All wells constructed at the ground surface must meet the following criteria:

- 1) The surface completion of the security structure must use structural rated concrete that meets or exceeds the structural loads anticipated for the site. A reinforcing mesh may be added to prevent freeze/thaw cracking of the surface seal.
- 2) The security vault/monument must be able to be properly secured to prevent access by unauthorized persons and vandalism.
- 3) Positive surface drainage away from the security vault/monument must be provided to prevent ponding around the well.

- 4) The well must be fitted with a water-tight, locking cap (the use of a slip cap is not acceptable).

Flush-Grade Well Head Construction

The well head must be completed below the surface grade in the vault. The referenced diagram provides minimum design standard for surface completion of a flush-grade well head security vault.



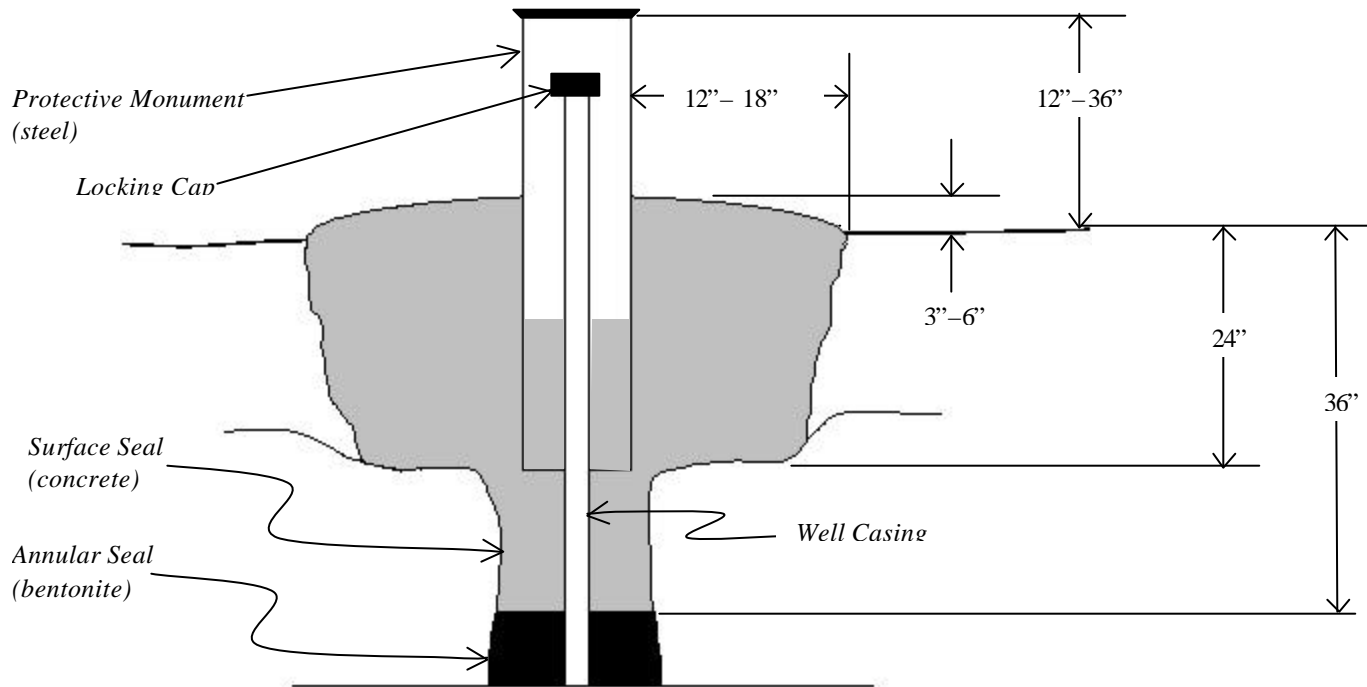
This type of surface construction is only applicable in traffic areas, paved areas and/or where the well will cause a safety problem. Any variation in these construction standards must be approved by the DEQ. The well head must be constructed in accordance with the following:

- 1) complete the well head below the surface grade of the vault;
- 2) in traffic areas and sidewalks, the vertical well profile must not exceed 1/2-inch to minimize physical hazards and maintain a smooth, travelable surface;
- 3) the well heads must be constructed in an area where the wells will not become flooded or damaged;
- 4) drainage around the well must be maintained so that no ponding of water will occur around the well head;
- 5) the casing must extend a minimum of 3-inches above the interior seal.
- 6) the security vault must be a traffic-rated, water-tight, locking structure that can withstand the maximum traffic loads anticipated for the site and extend to at least 12-inches below grade, and;
- 7) the surface seal must extend a minimum of 12-inches around the perimeter of the security vault and extend a minimum of 36-inches below ground surface to be contiguous with the annular seal.

The top of the well casing should be surveyed to an accurate datum by a properly licensed professional. See DEQ Technical Guidance #2 – *Licensed Surveyor Required for Determining Well Elevations*.

Monument Well Head Construction

The well head must be completed above the surface grade in the vault. The referenced diagram provides minimum design standard for above grade completion of a well head security monument.



This type of surface construction is applicable to non-traffic areas, non-paved areas, or where the well will not cause a safety problem. Any variation in these construction standards must be approved by the DEQ. The well head must be constructed in accordance with the following:

- 1) complete the well head above the surface grade;
- 2) the well pad must be designed and constructed so that it will have proper drainage away from the steel conductor casing;
- 3) drainage around the well must be maintained so that no ponding of water will occur around the well head;
- 4) protective steel posts (bollards) may be required around the well to provide protection to the well monument;
- 5) the surface seal must extend a minimum of 12-inches around the perimeter of the protective monument and extend a minimum of 24-inches below ground surface.
- 6) the protective well monument must extend a minimum of 24-inches below grade and rise minimum of 12-inches above grade, and;
- 7) the protective well monument should be painted a bright color to make ease with future locating.

The top of the well casing should be surveyed to an accurate datum by a properly licensed professional. See DEQ Technical Guidance #2 – *Licensed Surveyor Required for Determining Well Elevations*.